Project Summary 20

Control of the nanoscale morphology of bulk heterojunction solar cells via chemical assembly of low bandgap conjugated polymers on nanoparticle support

The project focuses on understanding of how covalent preorganization of conjugated polymers (CPs) grafted to nanoparticles affects their photovoltaic (PV) properties. Using surface-initiated Kumada polycondensation newly developed in the Dresden group, two series of hairy nanoparticles with systematically variable grafting density having low bandgap copolymer shell containing dithieno[3,2-b:2',3'-d]silole donor units and benzothiadiazole or naphthalene diimide acceptor units, will be synthesized. Solution-processed solar cells will be prepared from the two kinds of hairy particles in combination with PCBM at the Risø DTU. The influence of the grafting density on PV properties will be systematically investigated; the results will be compared with the performance of the corresponding linear CPs. An inherent advantage of our "preorganization" approach is that the chains formed by simultaneous polymerization from the surface automatically appear to be staked parallel to one another and stretched, which should favor charge and energy transport even in the case of typically amorphous random copolymers. Further, a fine engineering of the internal composition of the hairy particles, such as preparation of desired gradients and positioning of various functions at the periphery of the particles, should be straightforward with our graftingfrom approach that is a new and potentially powerful tool in regulation of self-assembly, charge-separation and charge-recombination processes.